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A Budget of Paradoxes. *By* Professor De Morgan.*

No. I. *Introduction.*

If I had before me a fly and an elephant, having never seen more than one such magnitude of either kind; and if the fly were to endeavour to persuade me that he was larger than the elephant, I might by possibility be placed in a difficulty. The apparently little creature might use such arguments about the effect of distance, and might appeal to such laws of sight and hearing as I, if unlearned in those things, might be unable wholly to reject. But if there were a thousand flies, all buzzing, to appearance, about the great creature; and, to a fly, declaring, each one for himself, that he was bigger than the quadruped; and all giving different and frequently contradictory reasons; and each one despising and opposing the reasons of the others—I should feel quite at my ease. I should certainly say, "My little friends, the case of each one of you is destroyed by the rest." I intend to show flies in the swarm; with a few larger animals, for reasons to be given.

In every age of the world there has been an established system, which has been opposed from time to time by isolated and dissentient reformers. The established system has sometimes fallen, slowly and gradually: it has either been upset by the rising influence of some one man, or it has been sapped by gradual change of opinion in the many.

I have insisted on the isolated character of the dissentients, as an element of the *à priori* probabilities of the case. Show me a schism, especially a growing schism, and it is another thing. The homœopathists, for instance, shall be, if any one so think, as wrong as St. John Long: but an organized opposition, supported by the efforts of many acting in concert, appealing to common arguments and experience, with perpetual succession and a common seal, as the Queen says in the charter, is, be the merit of the schism what it may, a thing wholly different from the case of the isolated opponent in the mode of opposition to it which reason points out.

During the last two centuries and a half, physical knowledge has been gradually made to rest upon a basis which it had not before. It has become *mathematical.* The question now is, not whether this or that hypothesis is better or worse to the pure thought, but whether it accords with observed phenomena in those consequences which can be shown necessarily to follow from it, if it be true. Even in those sciences which are not yet under the dominion of mathematics, and perhaps never will be, a working copy of the mathematical process has been made. This is not known to the followers of those sciences who are not themselves mathematicians, and who very often exalt their horns against the mathematics in consequence. They might as well be squaring the circle, for any sense they show in this particular.

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* We extract this from the *Athenæum*, and doubt not that our readers will welcome a Budget affording so much entertainment as well as instruction.—Ed. *A. M.*

A great many individuals, ever since the rise of the mathematical method, have, each for himself, attacked its direct and indirect consequences. I shall not here stop to point out how the very accuracy of exact science gives better aim than the preceding state of things could give. I shall call each of these persons a *paradoxer,* and his system a *paradox.* I use the word in the old sense: a paradox is something which is apart from general opinion, either in subject-matter, method, or conclusion.

Many of the things brought forward would now be called *crotchets,* which is the nearest word we have to old *paradox.* But there is this difference, that by calling a thing a *crotchet* we mean to speak lightly of it; which was not the necessary sense of *paradox.* Thus, in the sixteenth century, many spoke of the earth's motion as the *paradox of Copernicus,* who held the ingenuity of that theory in very high esteem, and some, I think, who even inclined towards it. In the seventeenth century, the depravation of meaning took place, in England at least. Phillips says paradox is "a thing which seemeth strange"; here is the old meaning: after a colon, he proceeds "and absurd, and is contrary to common opinion," which is an addition due to his own time.

After looking into books of paradoxes for more than thirty years, and holding conversation with many persons who have written them, and many who might have done so, there is one point on which my mind is fully made up. The manner in which a paradoxer will show himself, as to sense or nonsense, will not depend upon what he maintains, but upon whether he has or has not made a sufficient knowledge of what has been done by others, *especially as to the mode of doing it,* a preliminary to inventing knowledge for himself. That a little knowledge is a dangerous thing is one of the most fallacious of proverbs. A person of small knowledge is in danger of trying to make his *little* do the work of *more:* but a person without any is in more danger of making his *no* knowledge do the work of *some.* Take the speculations on the tides as an instance. Persons with nothing but a little geometry have certainly exposed themselves in their modes of objecting to results which require the higher mathematics to be known before an independent opinion can be formed on sufficient grounds. But persons with no geometry at all have done the same thing much more completely.

There is a line to be drawn which is constantly put aside in the arguments held by paradoxers in favour of their right to instruct the world. Most persons must, or at least will, like the lady in Cadogan Place, form and express an immense variety of opinions on an immense variety of subjects: and all persons must be their own guides in many things. So far all is well. But there are many who, in carrying the expression of their own opinions beyond the usual tone of private conversation, whether they go no further than attempts at oral proselytism, or whether they commit themselves to the press, do not reflect that they have ceased to stand upon the ground on which their process is defensible. Aspiring to lead *others,* they have never given themselves the fair chance of being first led by *other* others into something better than they can start for themselves: and that they should first do this is what both those classes of others have a fair right to expect. New knowledge, when to any purpose, must come by contemplation of old knowledge, in every matter which concerns thought: mechanical contrivance sometimes, not very often, escapes this rule. All the men who are now called discoverers, in every matter ruled by thought, have been men versed in the minds of their predecessors, and learned in what had been before them. There is not one exception. I do not say that every man has made direct acquaintance with the whole of his mental ancestry: many have, as I may say, only known their grandfathers by the report of their fathers. But even on this point it is remarkable how many of the greatest names in all departments of knowledge have been real antiquaries in their several subjects.

I may cite, among those who have wrought strongly upon opinion or practice in science, Aristotle, Plato, Ptolemy, Euclid, Archimedes, Roger Bacon, Copernicus, Francis Bacon, Ramus, Tycho Brahé, Galileo, Napier, Descartes, Leibnitz, Newton, Locke. I take none but names known out of their fields of work: and all were learned as well as sagacious. I have chosen my instances: if any one will undertake to show a person of little or no knowledge who has established himself in a great matter of pure thought, let him bring forward his man, and we shall see.

This is the true way of putting off those who plague others with their great discoveries. The first demand made should be—Mr. Moses, before I allow you to lead me over the Red Sea, I must have you show that you are learned in all the wisdom of the Egyptians, upon your own subject. The plea that it is unlikely that this or that unknown person should succeed where Newton, &c. have failed, or should show Newton, &c. to be wrong, is utterly null and void. It was worthily versified by Sylvanus Morgan (the great herald who in his "Sphere of Gentry" gave coat-armour to "*Gentleman Jesus*," as he said), who sang of Copernicus as follows (1652):—

> "If Tellus winged be,
> The earth a motion round;
> Then much deceived are they
> Who nere before it found.
> Solomon was the wisest,
> His wit nere this attained;
> Cease, then, Copernicus,
> Thy hypothesis vain."

Newton, &c. were once unknown: but they made themselves known by what they knew, and then brought forward what they could do; which I see is as good verse as that of Herald Sylvanus. The demand for previous knowledge disposes of twenty-nine cases out of thirty, and the thirtieth is worth listening to.

I have not set down Copernicus, Galileo, &c. among the paradoxers, merely because everybody knows them; if my list were quite complete, they would have been in it. But the reader will find Gilbert, the great precursor of sound magnetical theory; and several others on whom no censure can be cast, though some of their paradoxes are inadmissible, some unproved, and some capital jokes, true or false: the author of the *Vestiges of Creation* is an instance. I expect that my old correspondent, General Perronet Thompson, will admit that his geometry is part and parcel of my plan: and also that, if that plan embraced politics, he would claim a place for his *Catechism on the Corn Laws,* a work at one time paradoxical, but which had more to do with the abolition of the bread-tax than Sir Robert Peel.

My intention in publishing this budget in the *Athenæum,* is *to enable those who have been puzzled by one or two discoverers, to see how they look in the lump.* The only question is, has the selection been fairly made? To this my answer is, that no selection at all has been made. The books are, without exception, those which I have in my own library: and I have taken *all;* I mean all of the kind. Heaven forbid that I should be supposed to have no other books. But I may have been a collector, influenced in choice by bias? I answer that I never have collected books of this sort: that is, I have never searched for them, never made up my mind to look out for this book or that. I have bought what happened to come in my way at shop or auction; I have retained what came in as part of the *undescribed* portion of miscellaneous auction lots; I have received a few from friends who found them among what they called their rubbish; and I have preserved books sent to me for review. In not a few instances the books have been bound up with others, unmentioned at the back: and for years I knew no more I had them than I knew I had Lord Macclesfield's speech on moving the change of Style; which, after I had searched shops, &c., for it in vain, I found had been reposing on my own shelves for many years, at the end of a summary of Leibnitz's philosophy. Consequently, I may positively affirm that the following list is formed by accident and circumstance alone; and that it truly represents the casualties of about a third of a century. For instance, the large proportion of works on the quadrature of the circle is not my doing: it is the natural share of this subject in the actual run of events.

Before proceeding to open the budget, I say something on my personal knowledge of the class of discoverers who square the circle, upset Newton, &c. I suspect I know more of the English class than any man in Britain. I never kept any reckoning: but I know that one year with another—and less of late years than in earlier time—I have talked to more than five in each year, giving more than a hundred and fifty specimens. Of this I am sure, that it is my own fault if they have not been a thousand. Nobody knows how they swarm, except those to whom they naturally resort. They are in all ranks and occupations, of all ages and characters. They are very earnest people, and their purpose is *bonâ fide* the dissemination of their paradoxes. A great many—the mass indeed—are illiterate, and a great many waste their means, and are in or approaching penury. But I must say that never, in any one instance, has the quadrature of the circle, or the like, been made a pretext for begging: even to be asked to purchase a book is of rare occurrence.

These discoverers despise one another: if there were the concert among them which there is among foreign mendicants, a man who admitted one to a conference would be plagued to death. I once gave something to a very genteel French applicant, who overtook me in the street, at my own door, saying he had picked up my handkerchief: whether he picked it up in my pocket for an introduction, I know not. But that day week came another Frenchman to my house, and that day fortnight a French lady: both failed, and I had no more trouble. The same thing happened with Poles. It is not so with circle-squarers, &c.: they know nothing of each other. Some will read this list, and will say I am right enough, generally speaking, but that there *is* an exception, if I could but see it.

I do not mean, by my confession of the manner in which I have sinned against the twenty-four hours, to hold myself out as accessible to personal explanation of new plans. Quite the contrary: I consider myself as having made my report, and being discharged from further attendance on the subject. I will not, from henceforward, talk to any squarer of the circle, trisector of the angle, duplicator of the cube, constructor of perpetual motion, subverter of gravitation, stagnator of the Earth, builder of the universe, &c. I will receive any writings or books which require no answer, and read them when I please: I will certainly preserve them; this list may be enlarged at some future time.

There are three subjects which I have hardly anything upon: astrology, mechanism, and the infallible way of winning at play. I have never cared to preserve astrology. The mechanists make models, and not books. The infallible winners—though I have seen a few—think their secret too valuable, and prefer *mutare quadrata rotundis*—to turn dice into coin—at the gaming-house: verily they have their reward.

I shall now select, to the mystic number seven, instances of my personal knowledge of those who think they have discovered, in illustration of as many misconceptions.

1. *Attempt by help of the old philosophy, the discoverer not being in possession of modern knowledge.*—A poor schoolmaster, in rags, introduced himself to a scientific friend with whom I was talking, and announced that he had found out the composition of the sun. "How was that done?"—"By consideration of the four elements." —"What are they?"—"Of course, fire, air, earth, and water."— "Did you not know that air, earth, and water, have long been known to be no elements at all, but compounds?"—"What do you mean, Sir? Who ever heard of such a thing?"

2. *The notion that difficulties are enigmas, to be overcome in a moment, by a lucky thought.*—A nobleman of very high rank, now long dead, read an article by me on the quadrature, in an early Number of the *Penny Magazine*. He had, I suppose, school recollections of geometry. He put pencil to paper, drew a circle, and

constructed what seemed likely to answer, and, indeed, was—as he said—certain, if only this bit were equal to that; which of course it was not. He forwarded his diagram to the Secretary of the Diffusion Society, to be handed to the author of the article, in case the difficulty should happen to be therein overcome.

3. *Discovery at all hazards, to get on in the world.*—Thirty years ago, an officer of rank, just come from foreign service, and trying for a decoration from the Crown, found that his claims were of doubtful amount, and was told by a friend that so and so, who had got the order, had the additional claim of scientific distinction. Now this officer, while abroad, had bethought himself one day that there really could be no difficulty in finding the circumference of a circle: if a circle were rolled upon a straight line until the undermost point came undermost again, there would be the straight line, equal to the circle. He came to me, saying that he did not feel equal to the statement of his claim in this respect, but that if some clever fellow would put the thing in a proper light, he thought his affair might be managed. I was clever enough to put the thing in a proper light to himself, to this extent at least, that though perhaps they were wrong, the advisers of the Crown would never put the letters K.C.B. to such a circle as his.

4. *The notion that mathematicians cannot find the circle for common purposes.*—A working man measured the altitude of a cylinder accurately, and—I think the process of Archimedes was one of his proceedings—found its bulk. He then calculated the ratio of the circumference to the diameter, and found it answered very well on other modes of trial. His result was about 3·14. He came to London, and somebody sent him to me. I happened to have on the table a proof-sheet of the Astronomical Memoirs, in which were a large number of observed places of the planets compared with prediction, and asked him whether it could be possible that persons who did not know the circle better than he had found it could make the calculations, of which I gave him a notion, so accurately? He was perfectly astonished, and took the titles of some books, which he said he would read.

5. *Application for the reward from abroad.*—Many years ago, about twenty-eight, I think, a Jesuit came from South America, with a quadrature, and a cutting from a newspaper, announcing that a reward was ready for the discovery in England. On this evidence he came over. After satisfying him that nothing had ever been offered here, I discussed his quadrature, which was of no use. I succeeded better when I told him of Richard White,

also a Jesuit, and author of a quadrature published before 1648, under the name of *Chrysæspis,* of which I can give no account, having never seen it. This White (Albius) is the only quadrator who was ever convinced of his error. My Jesuit was struck by the instance, and promised to read more geometry—he was no Clavius—before he published his book. He relapsed, however, for I saw his book advertised in a few days. I may say, as a sufficient proof of my being no collector, that I had not the curiosity to buy this book; and my friend the Jesuit did not send me a copy, which he ought to have done, after the hour I had given him.

6. *Application for the reward at home.* — An agricultural labourer squared the circle, and brought the proceeds to London. He left his papers with me, one of which was the copy of a letter to the Lord Chancellor, desiring his Lordship to hand over forthwith one hundred thousand pounds, the amount of the alleged offer of reward. I returned his papers, with a note, stating that he had not the knowledge requisite to see in what the problem consisted. I got for answer a letter in which I was told that a person who could not see that he had done the thing should "change his business, and appropriate his time and attention to a Sunday school, to learn what he could, and keep the *litle* children from *durting* their *close.*" I also received a letter from a friend of the quadrator, informing me that I knew his friend had succeeded, and had been heard to say so. These letters were printed—without the names of the writers—for the amusement of the readers of *Notes and Queries,* First Series, xii. 57.

7. An elderly man came to me, to show me how the universe was created.—There was one molecule, which by vibration became—Heaven knows how!—the sun. Further vibration produced Mercury; and so on. I suspect the nebular hypothesis had got into the poor man's head by reading, in some singular mixture with what it found there. Some modifications of vibration gave heat, electricity, &c. I listened until my informant ceased to vibrate—which is always the shortest way—and then said, "Our knowledge of elastic fluids is imperfect." "Sir!" said he, "I see you perceive the truth of what I have said, and I will reward your attention by telling you what I seldom disclose, never except to those who can receive my theory: the little molecule whose vibrations have given rise to our solar system, is the Logos of St. John's Gospel!" He went away to Dr. Lardner, who would not go into the solar system at all: the first molecule settled the question. So hard upon poor discoverers are men of science who are not antiquaries

in their subject! On leaving, he said, "Sir! Mr. De Morgan received me in a very different way: he heard me attentively, and I left him perfectly satisfied of the truth of my system." I have had much reason to think that many discoverers, of all classes, believe they have convinced every one who is not peremptory to the verge of incivility.

In my next I begin my list, in chronological order. My readers will understand that my general expressions, when slighting or contemptuous, refer to the ignorant, who teach before they have learnt. In every instance, those of whom I am able to speak with respect, whether as right or wrong, have sought knowledge in the subject they were to handle before they completed their speculations. I shall further illustrate this at the conclusion of my list.

No. II. 1503—1600.

Aristotle, treating of the category of relation, denies that the quadrature has been found, but appears to assume that it can be done. Boethius, in his comment on the passage, says that it has been done since Aristotle, but that the demonstration is too long for him to give. Those who have no notion of the quadrature question may look at the *English Cyclopædia,* art. "Quadrature of the Circle."

> Tetragonismus. Id est circuli quadratura per Campanum, Archimedem Syracusanum, atque Boetium mathematicæ perspicacissimos adinventa.—At the end, Impressum Venetiis per Ioan. Bapti. Sessa. Anno ab incarnatione Domini, 1503. Die 28 Augusti.

This book has never been noticed in the history of the subject, and I cannot find any mention of it. The quadrature of Campanus takes the ratio of Archimedes, 7 to 22, to be absolutely correct; the account given of Archimedes is not a translation of his book; and that of Boetius has more than is in Boet*h*ius. This book must stand, with the next, as the earliest in print on the subject, until further showing: Murhard and Kastner have nothing so early. It is edited by Lucas Gauricus, who has given a short preface. Luca Gaurico, Bishop of Civita Ducale, an astrologer of astrologers, published this work at about thirty years of age, and lived to eighty-two. His works are collected in folios, but I do not know whether they contain this production. The poor fellow could never tell his own fortune, because his father neglected to note the hour and minute of his birth. But if there had been anything in astrology, he could have worked back, as Adams and Leverrier did when they caught Neptune: at sixty he could have examined every minute of his day of birth, by the events of his life, and so would have found the right minute. He could then have gone on, by rules of prophecy. Gauricus was the mathematical teacher of Joseph Scaliger, who did him no credit, as we shall see.

In hoc opere contenta Epitome....Liber de quadratura Circuli.... Paris, 1503, fol.

The quadrator is Charles Bovillus, who adopted the views of Cardinal Cusa, presently mentioned. Montucla is hard on his compatriot, who, he says, was only saved from the laughter of geometers by his obscurity. Persons must guard against most historians of mathematics in one point: they frequently attribute to *his own* age the obscurity which a writer has in *their own* time. This tract was printed by Henry Stephens, at the instigation of Faber Stapulensis, and is recorded by Dechales, &c. It was also introduced into the *Margarita Philosophica* of 1515, in the same appendix with the new perspective from Viator. This is not extreme obscurity, by any means. The quadrature deserved it: but that is another point.

Nicolai de Cusa Opera Omnia. Venice, 1514. 3 vols., folio.

The real title is "*Hæc accurata recognitio trium voluminum operum clariss. P. Nicolai Cusæ .... proxime sequens pagina monstrat.*" Cardinal Cusa, who died in 1464, is one of the earliest modern attempters. His quadrature is found in the second volume, and is now quite unreadable. In the early days every quadrator found a geometrical opponent, who finished him. Regiomontanus did this office for the Cardinal.

De Occulta Philosophia libri III. By Henry Cornelius Agrippa. Lyons, 1550, 8vo.

De incertitudine et vanitate scientiarum. By the same. Cologne, 1531, 8vo.

The first editions of these works were of 1530, as well as I can make out; but the first was in progress in 1510. In the second work Agrippa repents of having wasted time on the magic of the first: but all those who actually deal with demons are destined to eternal fire with Jamnes and Mambres and Simon Magus. This means, as is the fact, that his occult philosophy did not actually enter upon *black* magic, but confined itself to the power of the stars, of numbers, &c. The fourth book, which appeared after the death of Agrippa, and really concerns dealing with evil spirits, is undoubtedly spurious. It is very difficult to make out what

Agrippa really believed on the subject. I have introduced his books as the most marked specimens of treatises on magic, a paradox of our day, though not far from orthodoxy in his; and here I should have ended my notice, if I had not casually found something more interesting to the reader of our day.

Walter Scott, it is well known, was curious on all matters connected with magic, and has used them very widely. But it is hardly known how much pains he has taken to be correct, and to give the real thing. The most decided detail of a magical process which is found in his writings is that of Dousterswivel in *The Antiquary*: and it is obvious, by his accuracy of process, that he does not intend the adept for a mere impostor, but for one who had a lurking belief in the efficacy of his own processes, coupled with intent to make a fraudulent use of them. The materials for the process are taken from Agrippa. I first quote Mr. Dousterswivel:—

> " . . . . I take a silver plate when she [the moon] is in her fifteenth mansion, which mansion is in de head of *Libra*, and I engrave upon one side de worts *Schedbarschemoth Schartac*han [*ch* should be *t*]—dat is, de Intelligence of de Intelligence of de moon—and I make his picture like a flying serpent with a turkey-cock's head—vary well.—Then upon this side I make de table of de moon, which is a square of nine, multiplied into itself, with eighty-one numbers [nine] on every side, and diameter nine. . . ."

In the *De Occulta Philosophia*, p. 290, we find that the fifteenth mansion of the moon *incipit capite Libræ*, and is good *pro extrahendis thesauris*, the object being to discover hidden treasure. In p. 246, we learn that a *silver* plate must be used with the moon. In p. 248 we have the words which denote the Intelligence, &c. But, owing to the falling of a number into a wrong line, or the misplacement of a line, one or other—which takes place in all the editions I have examined—Scott has, sad to say, got hold of the wrong words: he has written down the *demon of the demons* of the moon. Instead of the gibberish above, it should have been *Malcha betharsisim hed beruah schehakim.* In p. 253 we have the magic square of the moon, with eighty-one numbers, and the symbol for the Intelligence, which Scott likens to a flying serpent with a turkey-cock's head. He was obliged to say something; but I will stake my character—and so save a woodcut—on the scratches being more like a pair of legs, one shorter than the other, without a body, jumping over a six-barred gate placed side uppermost. Those who thought that Scott forged his own nonsense, will henceforth stand corrected. As to the spirit Peolphan, &c., no doubt Scott got it from the authors he elsewhere mentions, Nicolaus Remigius and Petrus Thyracus: but this last word should be Thyræus.

Orontii Finæi....Quadratura Circuli. Paris, 1544, 4to.

Orontius squared the circle out of all comprehension; but he was killed by a feather from his own wing. His former pupil, John Buteo, the same who—I believe for the first time—calculated the question of Noah's ark, as to its power to hold all the animals and stores, unsquared him completely. Orontius was the author of very many works, and died in 1555. Among the laudatory verses which, as was usual, precede this work, there is one of a rare character: a congratulatory ode to the wife of the author. The French now call this writer Oronce Finée; but there is much difficulty about delatinization. Is this more correct than Oronce Fine, which the translator of De Thou uses? Or than Horonce Phine, which older writers give? I cannot understand why M. de Viette should be called Viète because his Latin name is Vieta. It is difficult to restore Buteo; for not only now is *butor* a blockhead as well as a bird, but we really cannot know what kind of bird Buteo stood for. We may be sure that Madame Fine was Denise Blanche; for Dionysia Candida can mean nothing else. Let her shade rejoice in the fame which Hubertus Sussannæus has given her.

I ought to add the quadrature of Orontius, and solutions of all the other difficulties, were first published in *De Rebus Mathematicis hactenus desideratis*, of which I have not the date.

Nicolai Raymari Ursi Dithmarsi Fundamentum Astronomicum, id est, nova doctrina sinuum et triangulorum.... Strasburg, 1588, 4to.

People choose the name of this astronomer for themselves: I take *Ursus*, because he *was* a bear. This book gave the quadrature of Simon Duchesne, or à Quercu, which excited Peter Metius, as presently noticed. It also gave that unintelligible reference to Justus Byrgius which has been used in the discussion about the invention of logarithms.

Jacobus Falco Valentinus, miles Ordinis Montesiani, hanc circuli quadraturam invenit. Antwerp, 1589, 4to.

The attempt is more than commonly worthless; but as Montucla and others have referred to the verses at the end, and as the tract is of the rarest, I will quote them:—

Circulus loquitur.

Vocabar ante circulus
Eramque curvus undique

Ut alta solis orbita
Et arcus ille nubium.
Eram figura nobilis
Carensque sola origine
Carensque sola termino.
Modo indecora prodeo
Novisque fœdor angulis.
Nec hoc peregit Archytas
Neque Icari pater neque
Tuus Iapete filius.
Quis ergo casus aut Deus
Meam quadravit aream?

Respondet auctor.

Ad alta Turiæ ostia
Lacumque limpidissimum
Sita est beata civitas
Parum Saguntus abfuit
Abestque Sucro plusculum.
Hic est poeta quispiam
Libenter astra consulens
Sibique semper arrogans
Negata doctioribus.
Senex ubique cogitans
Sui frequenter immemor
Nec explicare circinum
Nex exarare lineas
Sciens ut ipse prædicat.
Hic ergo bellus artifex
Tuam quadravit aream.

Falco's verses are pretty, if the ⏑ – mysteries be correct, which, with one exception,* I believe they are; but of these things I have forgotten—what I knew.

As a specimen of the way in which history is written, I copy the account which Montucla—who is accurate when he writes about what he has seen—gives of these verses. He gives the date 1587; he places the verses at the beginning instead of the end; he says the circle thanks its quadrator affectionately; and he says the good and modest chevalier gives all the glory to the patron saint of his order. All of little consequence, as it happens; but writing at second-hand makes as complete mistakes about more important matters.

Petri Bungi Bergomatis Numerorum mysteria. Bergomi [Bergamo], 1591, 4to. Second Edition.

The first edition is said to be of 1585; the third, Paris, 1618. Bungus is not for my purpose on his own score, but those who gave the numbers their mysterious characters: he is but a collector. He quotes or uses 402 authors, as we are informed by his list: this

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* Archȳtas.

just beats Warburton, whom some eulogist or satirist, I forget which, holds up as having used 400 authors in some one work. Bungus goes through 1, 2, 3, &c., and gives the account of everything remarkable in which each number occurs; his accounts not being always mysterious. The numbers which have nothing to say for themselves are omitted: thus there is a gap between 50 and 60. In treating 666, Bungus, a good Catholic, could not compliment the Pope with it, but he fixes it on Martin Luther with a little forcing. If from A to I represent 1–9, from K to S 10–90, and from T to Z 100–500, we see,

M A R T I N L U T E R A
30 1 80 100 9 40 20 200 100 5 80 1

which gives 666. Again, in Hebrew *Lulter* does the same:—

ל ו ל ת ר
200 400 30 6 30

And thus two can play at any game. The second is better than the first: to Latinize the surname and not the Christian name is very unscholarlike. The last number mentioned is a thousand millions: all greater numbers are dismissed in half a page. Then follows an accurate distinction between *number* and *multitude*—a thing much wanted both in arithmetic and logic.

What may be the use of such a book as this? The last occasion on which it was used was the following. Fifteen or sixteen years ago the Royal Society determined to restrict the number of yearly admissions to fifteen men of science, and noblemen *ad libitum;* the men of science being selected and recommended by the Council, with a power, since practically surrendered, to the Society to elect more. This plan appears to me to be directly against the spirit of their charter, the true intent of which is, that all who are fit should be allowed to promote natural knowledge in association, from and after the time at which they are both fit and willing. It is also working more absurdly from year to year; the tariff of fifteen per annum will soon amount to the practical exclusion of many who would be very useful. This begins to be felt already, I suspect. But, as appears above, the body of the Society has the remedy in its own hands. When the alteration was discussed by the Council, my friend the late Mr. Galloway, then one of the body, opposed it strongly, and inquired particularly into the reason why *fifteen*, of all numbers, was the one to be selected. Was it because fifteen is seven and eight, typifying the Old Testament Sabbath, and the New Testament day of the resurrection following? Was it because Paul strove fifteen days against Peter, proving that he was a doctor both of the Old and New Testament? Was it because the prophet Hoseah bought a lady for fifteen pieces of silver? Was it because, according to Micah, seven shepherds and eight chiefs should waste the Assyrians? Was it because Ecclesiastes commands equal reverence to be given to both Testaments—such was the interpretation—in the words "Give a portion to seven, and also to eight"? Was it because the waters of the Deluge rose fifteen cubits above the mountains?—or because they lasted fifteen decades of days? Was it because Ezekiel's temple had fifteen steps? Was it because Jacob's ladder has been supposed to have had fifteen steps? Was it because fifteen years were added to the life of Hezekiah? Was it because the feast of unleavened bread was on the fifteenth day of the month? Was it because the scene of the Ascension was fifteen stadia from Jerusalem? Was it because the stone-masons and porters employed in Solomon's temple amounted to fifteen myriads? &c. The Council were amused and astounded by the volley of fifteens which was fired at them: they knowing nothing about Bungus, of which Mr. Galloway—who did not, as the French say, indicate his sources—possessed the copy now before me. In giving this anecdote I give a specimen of the book, which is exceedingly rare. Should another edition ever appear, which is not very probable, he would be but a bungling Bungus who should forget the *fifteen* of the Royal Society.

A plain discoverie of the whole Revelation of St. John.... whereunto are annexed certain oracles of Sibylla.... Set Foorth by John Napier L. of Marchiston. London. 1611. 4to.

The first edition was Edinburgh, 1593, 4to. Napier always believed that his great mission was to upset the Pope, and that logarithms, and such things, were merely episodes and relaxations. It is a pity that so many books have been written about this matter, while Napier, as good as any, is forgotten and unread. He is one of the first who gave us the six thousand years. "There is a sentence of the house of Elias reserved in all ages, bearing these words: The world shall stand six thousand years, and then it shall be consumed by fire: two thousand yeares voide or without lawe, two thousand yeares under the law, and two thousand yeares shall be the daies of the Messias...."

I give Napier's parting salute: it is a killing dilemma:—

"In summar conclusion, if thou o *Rome* aledges thyselfe reformed, and to beleeue true Christianisme, then beleeue Saint *John* the Disciple, whome Christ loued, publikely here in this Reuelation proclaiming thy wracke, but if thou remain Ethnick in thy priuate thoghts, beleeuing the old Oracles of the *Sibyls* reuerently keeped somtime in thy *Capitol:* then doth here this *Sibyll* proclame also thy wracke. Repent therefore alwayes, in this thy latter breath, as thou louest thine Eternall salvation. *Amen.*"

—Strange that Napier should not have seen that this appeal could not succeed, unless the prophecies of the Apocalypse were no true prophecies at all.

No. III. 1600—1658.

De Magnete magneticisque corporibus, et de magno magnete tellure. By William Gilbert. London, 1600, folio.—There is a second edition; and a third, according to Watt.

Of the great work on the magnet there is no need to speak, though it was a paradox in its day. The posthumous work of Gilbert, *De Mundo nostro sublunari philosophia nova,* Amsterdam, 1651, 4to., is, as the title indicates, confined to the physics of the globe and its atmosphere. It has never excited attention: I should hope it would be examined with our present lights.

Elementorum Curvilineorium Libri tres. By John Baptista Porta. Rome, 1610, 4to.

This is a ridiculous attempt, which defies description, except that it is all about lunules. Porta was a voluminous writer. His printer announces fourteen works printed and four to come, besides thirteen plays printed, and eleven waiting. His name is, and will be, current in treatises on physics for more reasons than one.

Trattato della quadratura del cerchio. Di Pietro Antonio Cataldi. Bologna, 1612, folio.

Rheticus, Vieta and Cataldi, are the three untiring computers of Germany, France and Italy; Napier in Scotland and Briggs in England come just after them. This work claims a place as beginning with the quadrature of Pellegrino Borello of Reggio, who will have the circle to be exactly 3 diameters and $\frac{69}{484}$ of a diameter. Cataldi, taking Van Ceulen's approximation, works hard at the finding of integers which nearly represent the ratio. He had not then the *continued fraction,* a mode of representation which he gave the next year in his work on the square root. He has but twenty of Van Ceulen's thirty places, which he takes from Clavius: and any one might be puzzled to know whence the Italians got the result; Van Ceulen, in 1612, not having been translated from Dutch. But Clavius names his comrade Gruenberger, and attributes the approximation to them jointly, "Lud. a Collen et Chr. Gruenbergerus invenerunt," which he had no right to do, unless, to his private knowledge, Gruenberger had verified Van Ceulen. And Gruenberger only handed over twenty of the places. But here is one instance, out of many, of the polyglott character of the Jesuit body, and its advantages in literature.

Phillippi Lausbergii Cyclometriæ Novæ Libri Duo. Middleburg, 1616, 4to.

This is one of the legitimate quadratures, on which I shall here only remark, that by candlelight it is quadrature under difficulties, for all the diagrams are in red ink.

De Cometa anni 1618 dissertationes Thomæ Fieni et Liberti Fromondi ....Equidem Thomæ Fieni epistolica quæstio, An verum sit Cœlum moveri et Terram quiesceri? London, 1670, 8vo.

This tract of Fienus against the motion of the earth is a reprint of one published in 1619. I have given an account of it as a good summary of arguments of the time, in the *Companion to the Almanac* for 1836.

Willebrordi Snellii. R. F. Cyclometricus. Leyden, 1621, 4to.

This is a celebrated work on the approximative quadrature, which, having the suspicious word *cyclometricus,* must be noticed here for distinction.

Liberti Fromondi....Ant-Aristarchus, sive orbis terræ immobilis. Antwerp, 1631, 8vo.

This book contains the evidence of an ardent opponent of Galileo to the fact that Roman Catholics of the day did not consider the decree of the *Index* or of the *Inquisition* as a declaration of their *Church.* Fromond would have been glad to say as much, and tries to come near it, but confesses he must abstain. See *Suppl. Penny Cyclop.,* "Galileo," and *Eng. Cycl.,* "Motion of the Earth." The author of a celebrated article in the *Dublin Review,* in defence of the Church of Rome, seeing that Drinkwater Bethune makes use of the authority of Fromondus, but for another purpose, sneers at him for bringing up a "musty old Professor." If he had known Fromondus, and used him, he would have helped his own case, which is very meagre for want of knowledge.

Advis à Monseigneur l'eminentissime Cardinal Duc de Richelieu, sur la Proposition faicte par le Sieur Morin pour l'invention des longitudes. Paris, 1634, 8vo.

This is the Official Report of the Commissioners appointed by the Cardinal, of whom Pascal is the one now best known, to consider Morin's plan. See the full account in Delambre, *Hist. Astr. Mod.* ii. 236, &c.

Arithmetica et Geometria practica. By Adrian Metius. Leyden, 1640, 4to.

This book contains the celebrated approximation *guessed at* by his father, Peter Metius—namely, that the diameter is to the circumference as 113 to 355. The error is at the rate of about a foot in 2,000 miles. Peter Metius, having his attention called to the subject by the false quadrature of Duchesne, found that the ratio lay between $\frac{333}{106}$ and $\frac{377}{120}$. He then took the liberty of taking the mean of both numerators and denominators, giving $\frac{355}{113}$. He had no right to presume that this mean was better than either of the extremes; nor does it appear positively that he did so. He published nothing: but his son Adrian, when Van Ceulen's work showed how near his father's result came to the truth, first made it known in the work above. (See *Eng. Cycl.*, art. "Quadrature.")

A discourse concerning a new world and another planet, in two books. London, 1640, 8vo.

Cosmotheoros: or conjectures concerning the planetary worlds and their inhabitants. Written in Latin, by Christianus Huyghens. This translation was first published in 1698. Glasgow, 1757, 8vo. [The original is also of 1698.]

The first work is by Bishop Wilkins, being the third edition [first in 1638] of the first book, *That the Moon may be a Planet*; and the first edition of the second work, *That the Earth may be a Planet*. [See more under the reprint of 1802.] Whether other planets be inhabited or not, that is, crowded with organizations, some of them having consciousness, is not for me to decide; but I should be much surprised if, on going to one of them, I should find it otherwise. The whole dispute tacitly assumes that, if the stars and planets be inhabited, it must be by things of which we can form some idea. But for aught we know, what numbers of such bodies there are, so many organisms may there be, of which we have no way of thinking nor of speaking. This is seldom remembered: in like manner it is usually forgotten that the *matter* of other planets may be of different chemistry from ours. There may be no oxygen and hydrogen in Jupiter, which may have *gens* of its own. But this must not be said: it would limit the omniscience of the *à priori* school of physical inquirers, the larger half of the whole, and would be very *unphilosophical.* Nine-tenths of my best paradoxers come out from among this larger half, because they are just a little more than of it at their entrance.

There was a discussion on the subject some years ago, which began with—

> The plurality of worlds: an Essay. London, 1853, 8vo. [By Dr. Wm. Whewell, Master of Trinity College, Cambridge.] A dialogue on the plurality of worlds, being a supplement to the Essay on that subject. [First found in the second edition, 1854; removed to the end in subsequent editions, and separate copies issued.]

A work of sceptical character, insisting on analogies which prohibit the positive conclusion that the planets, stars, &c., are what we should call *inhabited* worlds. It produced several works and a large amount of controversy in reviews. The last predecessor of whom I know was—

> Plurality of Words....By Alexander Maxwell. Second Edition. London, 1820, 8vo.

This work is directed against the plurality by an author who does not admit modern astronomy. It was occasioned by Dr. Chalmers's celebrated discourses on religion in connexion with astronomy. The notes contain many citations on the gravity controversy, from authors now very little read; and this is its present value. I find no mention of Maxwell, not even in Watt. He communicated with mankind without the medium of a publisher; and, from Vieta till now, this method has always been favourable to loss of books.

There is a class of hypothetical creations which do not belong to my subject, because they are *acknowledged* to be fictions, as those of Lucian, Rabelais, Swift, Francis, Godwin, Voltaire, &c. All who have more positive notions as to either the composition or organization of other worlds, than the reasonable conclusion that our Architect must be quite able to construct millions of other buildings on millions of other plans, ought to rank with the writers just mentioned, in all but self-knowledge. Of every one of their systems I say, as the Irish Bishop said of Gulliver's book,—I don't believe half of it. Huyghens had been preceded by Fontenelle, who attracted more attention. Huyghens is very fanciful and very positive; but he gives a true account of his method. "But since there's no hopes of a Mercury to carry us such a journey, we shall e'en be contented with what's in our power: we shall suppose ourselves there...." And yet he says—"We have proved that they live in societies, have hands and feet...." Kircher had gone to the stars before him, but would not find any life in them, either animal or vegetable.

Nova Demonstratio immobilitatis terræ petita ex virtute magnetica. By Jacobus Grandamicus. Flexiæ (La Flèche), 1645, 4to.

No magnetic body can move about its poles: the earth is a magnetic body, therefore, &c. The iron and its magnetism are typical of two natures in one person; so it is said, "Si exaltatus fuero à terra, omnia traham ad me ipsum."

Controversiæ de vera circuli mensura....inter C. S. Longomontanum et Jo. Pellium. Amsterdam, 1647, 4to.

Longomontanus, a Danish astronomer of merit, squared the circle in 1644: he found out that the diameter 43 gives the square root of 18252 for the circumference; which gives 3·14185..... for the ratio. Pell answered him, and being a kind of circulating medium, managed to engage in the controversy names known and unknown, as Roberval, Hobbes, Carcavi, Lord Charles Cavendish, Pallieur, Mersenne, Tassius, Baron Wolzogen, Descartes, Cavalieri and Golius. Among them, of course, Longomontanus was made mincemeat: but he is said to have insisted on his discovery in his epitaph.

The great circulating mediums, who wrote to everybody, heard from everybody, and sent extracts to everybody else, have been Father Mersenne, John Collins, and the late Prof. Schumacher: all "late" no doubt, but only the last recent enough to be so styled. If M.C.S. should ever again stand for "Member of the Corresponding Society," it should raise an acrostic thought of the three. There is an allusion to Mersenne's occupation in Hobbes's reply to him. He wanted to give Hobbes, who was very ill at Paris, the Roman Eucharist: but Hobbes said, "I have settled all that long ago; when did you hear from Gassendi?" John Collins disseminated Newton, among others. Schumacher ought to have been called the postmaster-general of astronomy, as Collins was called the attorney-general of mathematics.

A late discourse....by Sir Kenelme Digby....Rendered into English by R. White. London, 1658, 12mo.

On this work see *Notes and Queries*, 2nd series, vii. 231, 299, 445, viii. 190. It contains the celebrated sympathetic powder. I am still in much doubt as to the connexion of Digby with this tract. Without entering on the subject here, I observe that in Birch's *History of the Royal Society*, to which both Digby and White belonged, Digby, though he brought many things before the Society, never mentioned the powder, which is connected only with the names of Evelyn and Sir Gilbert Talbot. The sympathetic powder was that which cured by anointing the weapon with its salve instead of the wound. I have long been convinced that it was efficacious. The directions were to keep the wound clean and cool, and to take care of diet, rubbing the salve on the knife or sword. If we remember the dreadful notions upon drugs which prevailed, both as to quantity and quality, we shall readily see that any way of *not* dressing the wound would have been useful. If the physicians had taken the hint, had been careful of diet, &c., and had poured the little barrels of medicine down the throat of a practicable doll, *they* would have had their magical cures as well as the surgeons. Matters are much improved now; the quantity of medicine given, even by orthodox physicians, would have been called infinitesimal by their professional ancestors. Accordingly, the College of Physicians has a right to abandon its motto, which is *Ars longa, vita brevis,* meaning *Practice is long, so life is short.*

(*To be continued.*)

Note on the Possibility of the Division of the Law of Mortality into Geometrical Series. By W. S. B. Woolhouse, F.R.A.S.

If the series of the numbers living which constitute the law of mortality could be approximately derived, by collecting together the corresponding terms of a limited number of geometrical progressions, it is evident that the mathematical formula involving any combination of life contingencies and of the interest of money would expand into a certain number of geometrical series, the summation of each of which might be easily expressed. Such a result, as a general principle, would not appear to be attainable, so far as can be judged by an example I have been induced to test with the Carlisle table. The investigation being rather neat, it may be worthy of insertion in the *Journal,* and, moreover, it might possibly be more successful if applied to some other table of mortality.

Suppose the number living at successive ages to be capable of being represented by the addition of the corresponding terms of three geometric series. Let α, β, γ, be the common ratios of the respective series, and N, N_1, N_2, N_3, &c., numbers living at consecutive ages, or at equal intervals of age; then, p, q, r, denoting certain numbers to be found, we must have

$$\begin{aligned} N &= p + q + r \\ N_1 &= p\alpha + q\beta + r\gamma \\ N_2 &= p\alpha^2 + q\beta^2 + r\gamma^2 \\ N_3 &= p\alpha^3 + q\beta^3 + r\gamma^3 \\ &\text{\&c.} \end{aligned}$$